CLAIMS

I claim:

1. A detection system for a bio-separation device having a separation channel, comprising:

a detection section along the separation channel defining a detection zone;

means for introducing excitation radiation axially at the detection zone as analytes pass the detection zone; and

means for detecting radiation emission from the detection zone.

2. The detection system as in claim 1, wherein the means for introducing excitation radiation axially comprises a fiber that is directed into an end of the detection section in proximity to the detection zone.

3. The detection section as in claim 2, wherein the excitation radiation is provided at one wavelength.

4. The detection system as in claim 2, further comprising a light transmitting material disposed between the fiber and the detection zone to guide excitation radiation to the detection zone.

5. The detection system as in claim 4, wherein the means for introducing excitation radiation axially further comprises a boundary material that surrounds the light transmitting material for guiding the excitation radiation from the fiber to the detection zone.

6. The detection system as in claim 5, wherein the light transmitting material has a refractive index greater than the refractive index of the boundary material to guide the excitation radiation from the fiber to the detection zone by internal reflection.

7. The detection system as in claim 6, wherein the boundary material is embodied in a tube.

8. The detection system as in claim 7, wherein the tube is made of Teflon and the light transmitting material comprises a gel.

9. The detection system as in claim 1, wherein the excitation radiation is provided at at least two wavelengths.

10. The detection system as in claim 9, wherein the means for introducing excitation radiation comprises at least two radiation sources providing radiation at different wavelengths.

11. The detection system as in claim 10, wherein the means for introducing excitation radiation comprises an optical element that channels the radiation from the two radiation sources into a single fiber directed at the detection zone.

12. The detection system as in claim 11, wherein the optical element comprises a beam splitter.

13. The detection system as in claim 11, wherein the radiation sources comprise Light Emitting Diodes.

14. The detection system as in claim 11, wherein the radiation sources comprise lasers.

15. The detection system as in claim 10, wherein the means of introducing excitation radiation comprises two fibers directed at the detection zone, wherein each fiber is coupled to one radiation source.

16. The detection system as in claim 1, further comprising means for axially detecting radiation emission from the detection zone.

17. The detection system as in claim 16, wherein the means for axially detecting radiation emission comprises a fiber that is directed into an end of the detection section in proximity to the detection zone.

18. The detection system as in claim 17, wherein the means for axially detecting radiation emission shares the same single fiber as the means for introducing excitation radiation axially to transmit excitation radiation and radiation emission.

19. The detection system as in claim 18, further comprising a confocal optical element that transmits excitation radiation and radiation emission.

20. The detection system as in claim 19, wherein the confocal optical element comprises micro-lenses.

21. The detection system as in claim 19, wherein the confocal optical element comprises a beam combiner.

22. The detection system as in claim 1, wherein the means for detecting radiation emission from the detection zone comprises a set of micro-lenses.

23. The detection system as in claim 1, wherein the means for detecting radiation emission from the detection zone comprises a curved reflective collector.

24. The detection system as in claim 23, wherein the curved reflective collector comprises one of a parabolic, ellipsoidal, toroidal, or spherical reflector.

25. The detection system as in claim 1, wherein the separation channel has a first width, and the detection zone has a second width larger than the first width.

26. The detection system as in claim 1 wherein the means for introducing excitation radiation axially comprises a radiation source and a light transmitting material disposed between the radiation source and the detection zone to guide excitation radiation to the detection zone.

27. The detection system as in claim 26 wherein the means for introducing excitation radiation axially further comprises a boundary material that surrounds the light emitting material for guiding the excitation radiation from the excitation source to the detection zone.

28. The detection system as in claim 1 wherein the analytes comprise a material that fluoresces in the presence of the excitation radiation, and the means for detecting radiation emission comprises means for detecting fluorescence emission of the material.

29. The detection system as in claim 1 wherein the radiation emission is at least one of:

fluorescene;

chemiluminescence; and

phosphorescence.

30. A bio-separation instrument, comprising:

a separation channel;

means for separating a sample in the separation channel into analytes; and

a detection system, comprising:

(a) a detection section along the separation channel defining a detection zone;

(b) means for introducing excitation radiation axially at the detection zone as analytes pass the detection zone; and

(c) means for detecting radiation emission from the detection zone.

31. A bio-separation instrument as in claim 30, wherein the separation channel is defined by a capillary column, and the means for separating a sample is configured to effect separation of the sample by electrophoresis.

32. A method for detecting analytes in a bio-separation device having a separation channel, comprising the steps of:

defining a detection zone in the separation channel;

introducing excitation radiation axially at the detection zone as analytes pass the detection zone; and

detecting radiation emission from the detection zone.

33. The method as in claim 32, wherein the analytes comprise a material that fluoresces in the presence of the excitation radiation, and the radiation emission is fluorescence emission of the material.